

**AMENDMENTS TO THE DRAWINGS**

The attached sheet of drawings includes changes to **Fig. 3**. This sheet, which includes **Fig. 3**, replaces the original sheet including **Fig. 3**. In **Fig. 3**, the formula “ $P = 4+16(4-3) + 256(3-2-1)*0 = 4+16 = 20$ ” has been amended to “ $P = 4+16(4-3) + 256(3-2-1) = 4+16 = 20$ .”

Attachment: Replacement Sheet  
Annotated Sheet Showing Changes

**REMARKS**

Reconsideration and withdrawal of the rejections set forth in the Office Action are respectfully requested in view of this amendment and the following reasons. By this amendment, claims 1-17 have been cancelled without prejudice or disclaimer, and new claims 18-29 have been added. Accordingly, claims 18-29 are pending in this application.

New claims 18-29 correspond to the patented claims of the European counterpart, EP 1 457 762 B1.

It is respectfully submitted that the above amendments introduce no new matter within the meaning of 35 U.S.C. §132.

Entry of the Amendment is proper under 37 C.F.R. §1.111 because it (a) places the application in *prima facie* condition for allowance for the reasons discussed herein; and (b) does not raise new issues requiring further search and/or consideration by the Examiner because similar subject matter was previously considered by the Examiner and thus further consideration and/or search by the Examiner is not warranted. For at least these reasons, entry of the present Amendment is therefore respectfully requested. Accordingly, Applicant requests reconsideration and timely withdrawal of the pending rejections for the reasons discussed below.

***Specification Objection***

The specification was objected to because of certain informalities.

The objected parts of the specification, i.e. at page 2, lines 22-23, at page 6, lines 18-19, and at page 8, line 20, have been amended to meet the Examiner's request, as indicated at page 2 of this paper.

Applicant respectfully notes that "each code track 34, 44, and 54 is divided into 32 angular increments in *a pseudo-random code*", not a pseudo-random mode, as indicated in the Office Action.

The objection to the specification as failing to provide proper antecedent basis for the term “the bearing arrangement” disclosed in claim 14 is rendered moot because claim 14 has been canceled without prejudice or disclaimer and no other new claim has such term.

Accordingly, Applicant respectfully requests withdrawal of the objection to the specification.

#### ***Claim Objection***

Claims 2, 4, 5, 12-14, and 16 were objected to because of certain informalities.

Claims 1-17 have been canceled without prejudice or disclaimer, thereby rendering this objection moot. Furthermore, Applicant respectfully submits that new claims 18-29 do not contain the informalities indicated by the Examiner.

#### ***Drawing Objection***

**Fig. 3** was objected to because the formula for P incorporated therein “ $256(3-2-1)*0$ ” appears incorrect. The drawings were objected to under 37 C.F.R. §1.83(a) as the drawings fails to show “the bearing arrangement” in claim 14.

In the Replacement Sheet for **Fig. 3**, the formula has been amended to have “ $256(3-2-1)$ .” Claim 14 has been canceled without prejudice or disclaimer, thereby this objection moot.

Accordingly, Applicant respectfully requests withdrawal of the objection to the drawings.

#### ***Rejections Under 35 U.S.C. §102***

Claim 1 stands rejected under 35 U.S.C. §102(b) as being allegedly anticipated by France Patent Publication No. 2,697,081 applied for by Periou (“Periou”).

Claim 1 has been canceled without prejudice or disclaimer, thereby rendering this rejection moot.

Furthermore, Applicant respectfully submits that new independent claim 18 is not anticipated by Periou for at least the following reasons.

In order for a rejection under 35 U.S.C. §102(b) to be proper, a single reference must disclose every claimed feature. To be patentable, a claim need only recite a single novel feature that is not disclosed in the cited reference. Thus, the failure of a cited reference to disclose one or more claimed features renders the 35 U.S.C. §102(b) rejection improper.

Here, in view of this framework, Applicant respectfully submits that it is clear that Periou fails to disclose every claimed feature of claim 18. Specifically, Periou shows a device for measuring the rotational angle with an encoding unit which encodes the number of measured value cycles. According to figure 2 of Periou, the encoding unit shows two code disks 8, 9 which are driven by means of reduction gears 18, 19. The two code disks are positioned on the same central axis. The code disks 8, 9 have code tracks 11, 12 respectively which are provided on the surfaces of the two code disks facing each other. Therefore, according to Periou, the device is restricted to two code disks only.

According to the claimed features, the code disks are of annular configuration so that more than two code disks can be arranged coaxially whereby the code tracks can be positioned in the same plane. This configuration is possible according to the invention because the gear wheels driving the code disks are annular with the gear teeth on the inner circumference and enclosing the code disks.

For the Examiner's information, Periou was also cited by the European Patent Office during the examination stage of the counterpart application as the most relevant reference. The European counterpart patent application was granted over Periou. A copy of the patented claims are attached hereto.

Accordingly, Applicant respectfully submits that claim 18 is allowable over Periou.

Claims 19-29 depend from claim 18 and are allowable for at least this reason. Since none of the other prior art of record discloses or suggests all the features of the claimed invention, Applicant respectfully submits that independent claim 18, and all the claims that depend therefrom, are allowable.

***Rejections Under 35 U.S.C. §103***

Claims 8, 9, 11-13, and 17 stand rejected under 35 U.S.C. §103(a) as being allegedly unpatentable over Periou in view of U.S. Patent No. 4,616,131 issued to Burkhardt (“Burkhardt”).

Claims 2-8 and 10-13 stand rejected under 35 U.S.C. §103(a) as being allegedly unpatentable over Periou in view of U.S. Patent No. 4,730,110 issued to Spaulding (“Spaulding”).

Claims 14-16 stand rejected under 35 U.S.C. §103(a) as being allegedly unpatentable over Periou and Spaulding as applied to claims 2-8 and 10-13 above, and further in view of U.S. Patent No. 4,616,131 issued to Gornick et al. (“Gornick”).

Claims 2-17 have been canceled without prejudice or disclaimer, thereby rendering this rejection moot.

Furthermore, Applicant respectfully submits that new claims 18-29 are not obvious over Periou in view of Burkhardt, Spaulding, and/or Gornick because assuming *arguendo* that the references may be combined and a reasonable expectation of success exists, the combined references do not disclose or suggest all of the claim features.

None of Burkhardt, Spaulding, and Gornick cures the deficiencies of Periou noted above with regard to the 102 rejection. Therefore, claims 18-29 are not obvious over the references, alone or in combined.

Appl. No. 10/798,781  
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Response to Office Action mailed  
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Accordingly, Applicant respectfully submits that independent claim 18, and all the claims that depend therefrom, are allowable.

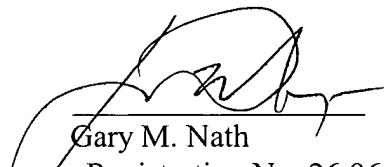
**CONCLUSION**

Applicant believes that a full and complete response has been made to the pending Office Action and respectfully submits that all of the stated objections and grounds for rejection have been overcome or rendered moot. Accordingly, Applicant respectfully submits that all pending claims are allowable and that the application is in condition for allowance.

Should the Examiner feel that there are any issues outstanding after consideration of this response, the Examiner is invited to contact Applicant's undersigned representative at the number below to expedite prosecution.

Prompt and favorable consideration of this Reply is respectfully requested.

Respectfully submitted,  
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ANNOTATED SHEET

$$15 \quad \text{Absolute Value} = S_1 + 16(S_1 - S_2) + 256(S_2 - S_3 - 1)$$

Disk 1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Disk 2	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Disk 3	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

$$P=0+16(0-0)+256(0-0)=0$$

$$P=4+16(4-3)+256(3-2-1)*0+4+16=20$$

Fig. 3



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## (12) EUROPÄISCHE PATENTSCHRIFT

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## (54) Vorrichtung zur Messung der Position, des Weges oder des Drehwinkels eines Objektes

Device for measuring the position, the displacement or the rotational angle of an object

Dispositif pour mesurer la position, le déplacement ou l'angle de rotation d'un objet

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(56) Entgegenhaltungen:  
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FR-A- 2 697 081 US-A- 4 572 951  
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Anmerkung: Innerhalb von neun Monaten nach der Bekanntmachung des Hinweises auf die Erteilung des europäischen Patents kann jedermann beim Europäischen Patentamt gegen das erteilte europäische Patent Einspruch einlegen. Der Einspruch ist schriftlich einzureichen und zu begründen. Er gilt erst als eingeleitet, wenn die Einspruchsgebühr entrichtet worden ist. (Art. 99(1) Europäisches Patentübereinkommen).

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7. Vorrichtung nach einem der vorhergehenden Ansprüche,  
dadurch gekennzeichnet, dass die komplette Codereinheit als elektronisches Bauteil ausgebildet ist, das zur Bestückung von Leiterplatten geeignet ist. 5

8. Vorrichtung nach einem der vorhergehenden Ansprüche,  
dadurch gekennzeichnet, dass sich die Untersetzungsverhältnisse, mit welchen zwei jeweils aufeinanderfolgende Codescheiben (3, 4 bzw. 4, 5) angetrieben werden, um 1/2<sup>n</sup> unterscheiden. 10

9. Vorrichtung nach Anspruch 8,  
dadurch gekennzeichnet, dass die Antriebszahnräder (21, 22) jeweils 15 Zähne aufweisen und die eine Codescheibe 60 Zähne und die andere 64 Zähne aufweist. 15

10. Vorrichtung nach Anspruch 9,  
dadurch gekennzeichnet, dass die Codereinheit drei Codescheiben (3, 4, 5) aufweist, so dass 4096 Messwertzyklen gezählt werden können. 20

11. Vorrichtung nach einem der vorhergehenden Ansprüche,  
dadurch gekennzeichnet, dass die Codescheiben (3, 4, 5) jeweils eine absolut codierte Winkelstellung mit 32 Winkelschritten aufweisen. 25

12. Vorrichtung nach Anspruch 11,  
dadurch gekennzeichnet, dass die Codierung der Winkelteilung durch einen Pseudorandom-Code mit jeweils mindestens 2 x 5 Bit gebildet ist. 30

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ment value cycles is determined from the mutual angular position of the code discs (3, 4, 5), characterized in that the gears (30, 40, 45, 50) of all code discs (3, 4, 5) are of annular configuration, in that the code discs are mounted one against the other such that they are freely rotatable, in that the code tracks (34, 44, 54) of the angle codings of the code discs (3, 4, 5) are located in a single plane on concentrically disposed annular discs (33, 43, 53) in the free interior of the gears (30, 40, 45, 50), and in that the code tracks (34, 44, 54) of all code discs (3, 4, 5) are irradiated by a joint light transmitter (14) with light path running in the free interior of the gears (30, 40, 45, 50) and are scanned by a scanner (15) radially sweeping the code tracks (34, 44, 54) of all code discs (3, 4, 5).

2. Device according to Claim 1, characterized in that two gears (30, 40 and 45, 50) of the respectively successive code discs (3, 4 and 4, 5) are driven by a joint drive gear (21 and 22), which at the outer periphery engages in the two gears (30, 40 and 45, 50) and extends axially over the two gears (30, 40 and 45, 50). 20

3. Device according to Claim 1 or 2, characterized in that the light transmitter (14) is disposed on a base plate (10) supporting the mounting of the code discs (3, 4, 5) and of the drive gears (21, 22), and in that the scanner (15) is disposed on a cover plate (12) placed opposite the base plate (10). 25

4. Device according to Claim 3, characterized in that the base plate (10) and the cover plate (12) are configured as printed circuit boards. 30

5. Device according to Claim 3 or 4, characterized in that the base plate (10) and the cover plate (12) close off axially at both ends a housing part (11), which accommodates the code discs (3, 4, 5). 35

6. Device according to one of Claims 1 to 5, characterized in that the code discs (3, 4, 5) with their respective gears (30, 40, 45, 50) and their annular discs (33, 43, 53) bearing the code tracks (34, 44, 54) are one-piece injection mouldings made of a light-transparent plastic. 40

7. Device according to one of the preceding claims, characterized in that the complete coding unit is configured as an electronic component, which is suitable for the assembly of printed circuit boards. 45

8. Device according to one of the preceding claims, characterized in that the gear reduction ratios with which two respectively successive code discs (3, 4 and 4, 5) are driven differ by 1/2<sup>n</sup>. 50

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9. Device according to Claim 8, characterized in that the drive gears (21, 22) respectively have 15 teeth and one code disc has 60 teeth and the other 64 teeth.

10. Device according to Claim 9, characterized in that the coding unit has three code discs (3, 4, 5), so that 4096 measurement value cycles can be counted.

11. Device according to one of the preceding claims, characterized in that the code discs (3, 4, 5) respectively have an absolutely coded angle scale comprising 32 angular steps.

12. Device according to Claim 11, characterized in that the coding of the angle scale is formed by a pseudorandom code having respectively at least  $2 \times 5$  bits.

## Revendications

1. Dispositif pour mesurer la position, le trajet ou l'angle de rotation d'un objet, comprenant une mesure matérialisée pouvant être balayée et pouvant être reliée à l'objet, qui associe à une zone de position de l'objet des valeurs de mesure, ces valeurs de mesure se répétant de manière cyclique dans des zones de position successives de l'objet, et comprenant une unité de codage qui code le nombre de cycles de mesure continus et présente au moins deux disques de codage entraînés par la mesure matérialisée via des réducteurs, les disques de codage (3, 4, 5) présentant un codage angulaire absolu (34, 44, 54), les disques de codage (3, 4, 5) étant disposés de façon coaxiale et présentant des roues dentées (30, 40, 45, 50) disposées de manière axialement décalées les unes par rapport aux autres, les disques de codage respectivement successifs (3, 4 ou 4, 5) étant couplés par un engrenage denté différentiel (21, 30, 40 ou 22, 45, 50) de telle sorte qu'ils sont entraînés conjointement au moyen d'une roue dentée d'entraînement (21 ou 22) et que leurs roues dentées (30, 45, 45, 50) présentent respectivement des nombres de dents différents, et le nombre de cycles de valeurs de mesure continus étant déterminé à partir de la position angulaire mutuelle des disques de codage (3, 4, 5), caractérisé en ce que les roues dentées (30, 40, 45, 50) de tous les disques de codage (3, 4, 5) sont configurés en forme d'anneau circulaire et les disques de codage sont logés de manière librement rotative les uns contre les autres, les pistes de codage (34, 44, 54) des codages angulaires des disques de codage (3, 4, 5) se trouvent dans un plan sur des disques annulaires circulaires (33, 43, 53) et disposées de manière concentrique dans l'espace intérieur libre des roues dentées (30, 40, 45, 50), et les pistes de codage (34, 44, 54)

de tous les disques de codage (3, 4, 5) sont traversées par un trajet lumineux s'étendant dans l'espace intérieur libre des roues dentées (30, 40, 45, 50) et provenant de l'émetteur de lumière (14), et sont balayées par un dispositif de balayage (15) couvrant radialement les pistes de codage (34, 44, 54) de tous les disques de codage (3, 4, 5).

2. Dispositif selon la revendication 1, caractérisé en ce que deux roues dentées (30, 40 ou 45, 50) des disques de codage respectivement successifs (3, 4 ou 4, 5) sont entraînées par une roue dentée d'entraînement commune (21 ou 22) qui s'engage au niveau de sa périphérie extérieure dans les deux roues dentées (30, 40 ou 45, 50) et s'étend axialement au-delà des deux roues dentées (30, 40 ou 45, 50).

3. Dispositif selon la revendication 1 ou 2, caractérisé en ce que l'émetteur de lumière (14) est disposé sur une plaque de base (10) qui porte le logement des disques de codage (3, 4, 5) et les roues dentées d'entraînement (21, 22), et le dispositif de balayage (15) est monté sur une plaque de couvercle (12) opposée à la plaque de base (10).

4. Dispositif selon la revendication 3, caractérisé en ce que la plaque de base (10) et la plaque de couvercle (12) sont des cartes de circuit imprimé.

5. Dispositif selon la revendication 3 ou 4, caractérisé en ce que la plaque de base (10) et la plaque de couvercle (12) ferment axialement aux deux extrémités une partie de boîtier (11), qui reçoit les disques de codage (3, 4, 5).

6. Dispositif selon l'une des revendications 1 à 5, caractérisé en ce que les disques de codage (3, 4, 5), avec leurs roues dentées respectives (30, 40, 45, 50) et leurs disques annulaires circulaires (33, 43, 53) portant les pistes de codage (34, 44, 54), sont des pièces moulées par injection faites d'une seule pièce en une matière plastique translucide.

7. Dispositif selon l'une des revendications précédentes, caractérisé en ce que l'unité de codage complète un composant électronique approprié pour le garnissage de cartes de circuit imprimé.

8. Dispositif selon l'une des revendications précédentes, caractérisé en ce que